

IN THE CLAIMS

1.-3. (Cancelled)

4. (Currently Amended) A method for data mirroring, comprising: ~~the steps of~~
receiving change data from a source, the change data received in a mirroring
unit; mirroring data and
storing a changed logical block number~~numbers~~ in a buffer in the mirroring unit, the
changed logical block number indicating a logical block on the source corresponding to the
change data rather than storing changed data in the buffer.

5. (Cancelled)

6. (Currently Amended) A computer storage ~~medium~~ apparatus comprising:
means for receiving change data from a source, the change data received in a mirroring
unit; mirroring data; and
means for storing a changed logical block number~~numbers~~ in a ~~circular~~ buffer in the
mirroring unit, the changed logical block number indicating a logical block on the source
corresponding to the change data rather than storing changed data in the ~~circular~~ buffer.

7.-9. (Cancelled)

10. (Currently Amended) The computer storage apparatus ~~mirroring unit~~ of claim 6 9,
wherein the means for storing the changed logical block number further comprises a data ~~virtual~~
block allocation structure ~~including~~ includes block checksums ~~rather than block~~ corresponding to
the change data.

11. (Currently Amended) The computer storage apparatus ~~mirroring unit~~ of claim 10,
further comprising means for transmitting the ~~wherein the mirroring unit transmits~~ block
checksums across a journey link to a ~~another~~ mirroring unit rather than transmitting block change

data across the journey link during a resynchronization of the ~~two mirroring unit units and the~~
computer storage apparatus.

12.-16. (Cancelled)

17. (Currently Amended) A method for data mirroring, comprising ~~the steps of~~
mirroring data, snooping a bus,
monitoring a first bus over which a host and a first storage volume for the host
communicate;
~~and buffering at least one command obtained by the snooping step.~~
buffering a communication on the first bus between the host and the first storage volume;
and
repeating the communication to a second storage volume in a mirroring unit through a
second bus.

18. (Currently Amended) The method of claim 17, further comprising ~~the step of~~
dividing commands within the communication into read nature commands ~~and from~~ write
nature commands, ~~the read nature commands being requests from a host controller on the~~
~~snooped bus that are of a read nature, the write nature commands being commands from a host~~
~~controller on the bus that are of a write nature, and~~
wherein buffering the communication further comprises the buffering step buffers write
nature commands.

19. (Currently Amended) The method of claim 17, further comprising ~~the step of~~
transferring buffered commands from a first mirroring unit to a second transmitting the buffered
communication to the mirroring unit across a communication link.

20. (Currently Amended) The method of claim ~~19~~17, further comprising ~~the step of~~
replaying repeating the communication to a third storage volume in an additional mirroring unit
through a third bus.
~~from a second mirroring unit commands which were buffered by a first mirroring unit.~~

21. (Currently Amended) A computer storage ~~medium~~ apparatus comprising:
~~means for mirroring data;~~
~~means for snooping a SCSI bus; and~~
means for monitoring a first bus over which a host and a first storage volume for the host
communicate;
~~means for buffering at least one SCSI command obtained by the means for snooping the~~
~~SCSI bus;~~
means for buffering a communication on the first bus between the host and the first
storage volume;
means for repeating the communication to a second storage volume in the mirroring unit
through a second bus.

22. (Currently Amended) The ~~configured-medium~~ computer storage apparatus of claim 21, wherein the means for buffering the communication on the first bus further comprises means
for buffering ~~step~~-buffers at least one write command.

23. (Currently Amended) The ~~configured-medium~~ computer storage apparatus of claim 21, further comprising:
means for transmitting the communication to another wherein the method further
comprises the step of replaying from a second mirroring unit; and
means for repeating the communication to a third storage volume in the additional
mirroring unit through a third bus ~~commands which were buffered by a first mirroring unit.~~

24. (Currently Amended) ~~A data mirroring system~~ The computer storage apparatus of
claim 21, wherein the first bus further comprises comprising a SCSI bus, and at least one means
for mirroring data, for snooping the SCSI bus, and for buffering a SCSI command obtained by
snooping.

25.-28. (Cancelled)

29. (Currently Amended) A method for data mirroring, comprising: ~~the steps of reading a block of data from a local mirror, writing that block of data to a temporary storage as a new block, updating a logical block number entry in a queue, writing the new block to a collection of mirror data, and adding a new block logical block number entry to the queue.~~

receiving change data;

reading a block of data from a mirror, wherein a first logical block number corresponding to a first logical block on the mirror storing the block of data is already a part of an existing entry in a queue;

writing the block of data to a second logical block on a temporary storage;

changing the existing entry in the queue to reference a second logical block number corresponding to the second logical block on the temporary storage;

writing the change data to the first logical block on the mirror; and

adding a new entry to the queue, the new entry including the first logical block number.

30. (Currently Amended) A computer storage medium comprising:

~~means for reading a block of data from a local mirror;~~

~~means for writing that block of data to a temporary storage as a new block;~~

~~means for updating a logical block number entry in a data structure;~~

~~means for writing the new block to a collection of mirror data; and~~

~~means for adding a new block logical block number entry to the data structure.~~

means for receiving change data;

means for reading a block of data from a mirror, wherein a first logical block number corresponding to a first logical block on the mirror storing the block of data is already a part of an existing entry in a queue;

means for writing the block of data to a second logical block on a temporary storage;

means for changing the existing entry in the queue to reference a second logical block number corresponding to the second logical block on the temporary storage;

means for writing the change data to the first logical block on the mirror; and

means for adding a new entry to the queue, the new entry including the first logical block number.

31.-41 (Cancelled)

42. (Currently Amended) A method for data storage management, comprising ~~the steps of reading data and maintaining an ordered queue of mirrored data elements and a current copy of mirrored data elements on the same physical storage system, the ordered queue and the current copy representing a plurality of previous current sets, whereby it is not necessary to write the same data element twice to the storage system to implement a physically-partitioned system.~~

_____ creating a set of mirrored data elements in a mirroring unit, the first set of mirrored data elements including all data of a mirrored volume at a first time;

maintaining the set of mirrored data elements; and

_____ maintaining an ordered queue of change data in the mirroring unit, wherein a combination of at least one entry of the ordered queue and the set of mirrored data elements includes all data of the mirrored volume at a second time.

43. (Currently Amended) A computer storage ~~apparatus medium~~ comprising:

~~means for reading data; and~~

~~means for maintaining an ordered queue of mirrored data elements and a current copy of mirrored data elements on the same physical storage system, the ordered queue and the current copy representing a plurality of previous current sets.~~

_____ means for creating a set of mirrored data elements in a mirroring unit, the first set of mirrored data elements including all data of a mirrored volume at a first time;

means for maintaining the set of mirrored data elements; and

_____ means for maintaining an ordered queue of change data in the mirroring unit, wherein a combination of at least one entry of the ordered queue and the set of mirrored data elements includes all data of the mirrored volume at a second time.

44. (Currently Amended) An article of computer readable code, embodied on a computer readable storage medium, that, when executed, causes the computer to:

_____ create a set of mirrored data elements in a mirroring unit, the first set of mirrored data elements including all data of a mirrored volume at a first time;

maintain the set of mirrored data elements; and
maintain an ordered queue of change data in the mirroring unit, wherein a combination of
at least one entry of the ordered queue and the set of mirrored data elements includes all data of
the mirrored volume at a second time.

An improved data storage management system, the improvement comprising software for maintaining an ordered data structure of mirrored data elements and a current copy of mirrored data elements on the same physical storage system, the ordered queue and the current copy representing a plurality of previous current sets.

45. (New) The method of claim 42, further comprising:

selecting an entry of the ordered queue; and

storing the set of mirrored data elements as modified by the selected entry and any older entries of the ordered queue in the mirrored volume.

46. (New) The method of claim 42, further comprising:

changing the set of mirrored data elements in response to an oldest entry of the ordered queue; and

removing the oldest entry from the ordered queue.

47. (New) The method of claim 4, further comprising:

storing change data in the buffer if a remaining storage in the buffer is greater than a threshold;

wherein storing the changed logical block number in the buffer further comprises storing the changed logical block number in the buffer instead of the change data if the remaining storage in the buffer is less than the threshold.

48. (New) The method of claim 4, wherein receiving the change data from the source further comprises receiving the change data from a local mirror, the local mirror including a mirror of a storage volume of a host.

49. (New) The method of claim 4, wherein receiving the change data from the source further comprises receiving the change data from a host, the change data corresponding to a data change on a storage volume of the host.

50. (New) The method of claim 4, wherein:
receiving the change data further comprises receiving the change data corresponding to a change in a block referenced by a changed logical block number entry already in the buffer; and
storing the changed logical block number in the buffer further comprising changing the changed logical block number entry from the changed logical block number to another logical block number, data in the block before the change stored in a location referenced by the other logical block number.

51. (New) The method of claim 4, wherein storing the changed logical block number in the buffer further comprises storing the changed logical block number in the buffer without storing the change data.

52. (New) The method of claim 29, wherein:
receiving the change data further comprises receiving the change data from a host; and
reading the block of data from the mirror further comprises reading the block of data from a full mirror of a storage volume on the host.

53. (New) The method of claim 42, wherein maintaining the set of mirrored data elements and maintaining the ordered queue of change data further comprises maintaining the set of mirrored data elements and maintaining the ordered queue of change data on the same physical storage system.